



National Semiconductor Corporation

2900 Semiconductor Drive, Santa Clara, California 95051

T NELSON

BOX 3
SCHOOL



MM421/MM521 1024 bit read only memory

general description

The MM421/521 is a 1024-bit static read only memory. It is a P-channel enhancement mode monolithic MOS integrated circuit utilizing low threshold technology. The device is a non-volatile memory organized as 256-4 bit words. Programming of the memory contents is accomplished by changing one mask during device fabrication.

features

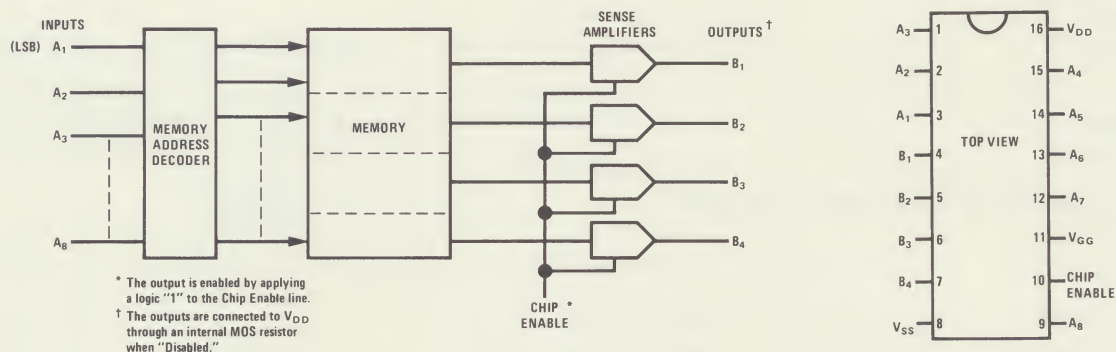
- Bipolar Compatibility
- High Speed Operation — $<1.0 \mu\text{s}$ TYP

- Static Operation — no clocks required
- Common Data Bussing — output wire AND capability
- Chip Enable Output Control

applications

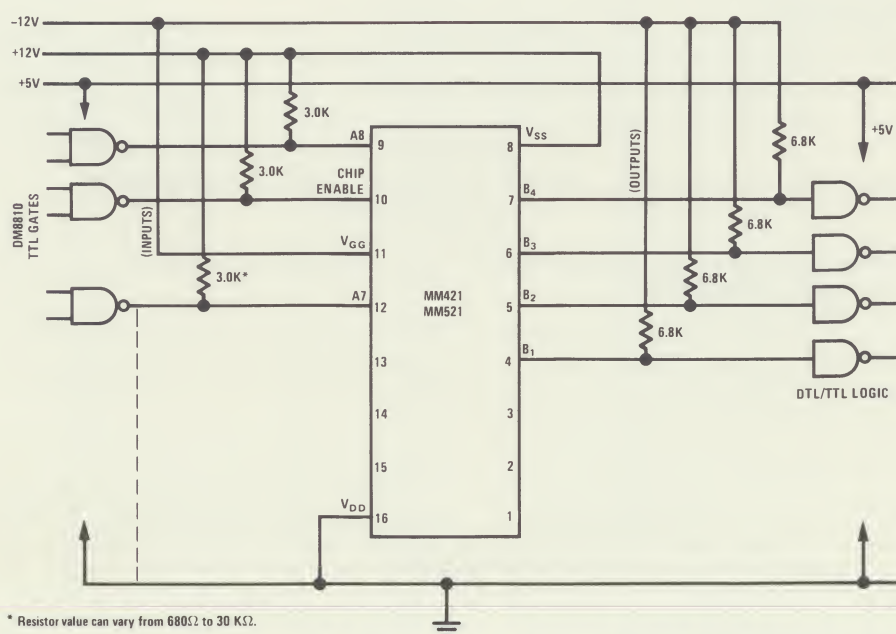
- Code Conversion
- Random Logic Synthesis
- Table Look-up
- Character Generators
- Micro-programming

block and connection diagrams



typical application

256 x 4 Bit ROM Showing TTL Interface



absolute maximum ratings

V_{GG} Supply Voltage	$V_{SS} - 30V$
V_{DD} Supply Voltage	$V_{SS} - 15V$
Input Voltage	$(V_{SS} - 20)V < V_{IN} < (V_{SS} + 0.3)$
Storage Temperature	$-65^{\circ}C$ to $+150^{\circ}C$
Operating Temperature MM421	$-55^{\circ}C$ to $+125^{\circ}C$
MM521	$-25^{\circ}C$ to $+70^{\circ}C$
Lead Temperature (Soldering, 10 sec)	$300^{\circ}C$

electrical characteristics (Note 1)

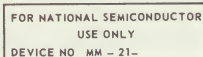
PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Output Voltage Levels					
MOS to MOS					
Logical "1"	1 M Ω to GND Load	$V_{SS} - 1.0$		$V_{SS} - 9.0$	V
Logical "0"					V
MOS to TTL					
Logical "1"	6.8 k Ω to V_{GG} Plus One Standard Series 54/74 Gate Input	+2.5		+0.4	V
Logical "0"					V
Input Voltage Levels					
Logical "1"		$V_{SS} - 2.0$		$V_{SS} - 8.0$	V
Logical "0"					V
Power Supply Current Requirements	$T_A = 25^{\circ}C$				
V_{SS}			20	35	mA
V_{GG} (Note 2)				1	μA
Input Leakage	$V_{IN} = V_{SS} - 12V$			1	μA
Input Capacitance	$f = 1.0$ MHz $V_{IN} = 0V$		5		pF
Address Time (Note 3)	$T_A = 25^{\circ}C$				
T_{A1}	See Timing Diagram		550	1000	ns
T_{A0}			600	1000	ns
Output AND Connection	MOS Load			4	
	TTL Load			10	

Note 1: These specifications apply for $V_{SS} = +12V \pm 10\%$ and $V_{GG} = -12V \pm 10\%$ and $T_A = -55^{\circ}C$ to $+125^{\circ}C$ (MM421), $T_A = -25^{\circ}C$ to $70^{\circ}C$ (MM521) unless otherwise specified.

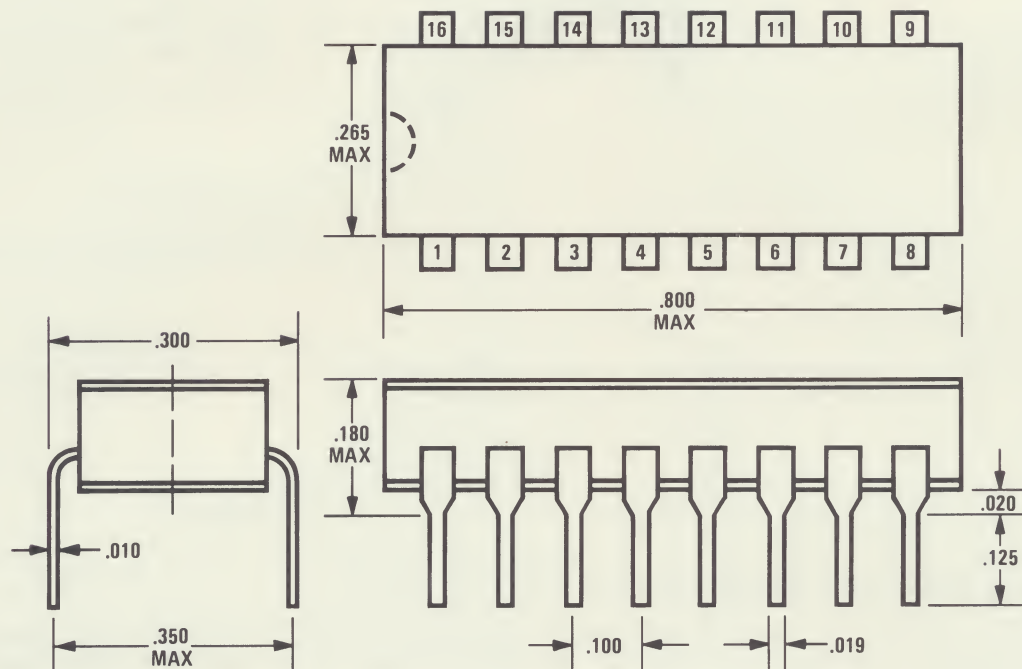
Note 2: The V_{GG} supply may be clocked to reduce device power without affecting access time.

Note 3: Address time is measured from the change of data on any input or Chip Enable line to the output of a TTL gate. (See Timing Diagram.)

MM421/MM521 1024 bit read only memory



physical dimensions



Hermetic Dual-In-Line Package
Order Number MM421 or MM521

National Semiconductor Corporation

2900 Semiconductor Drive, Santa Clara, California 95051
(408) 732-5000 / TWX (910) 339-9240





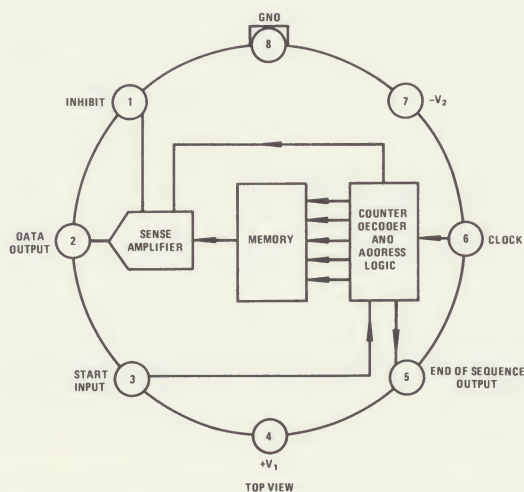
MM420/MM520 256 bit read only memory

general description

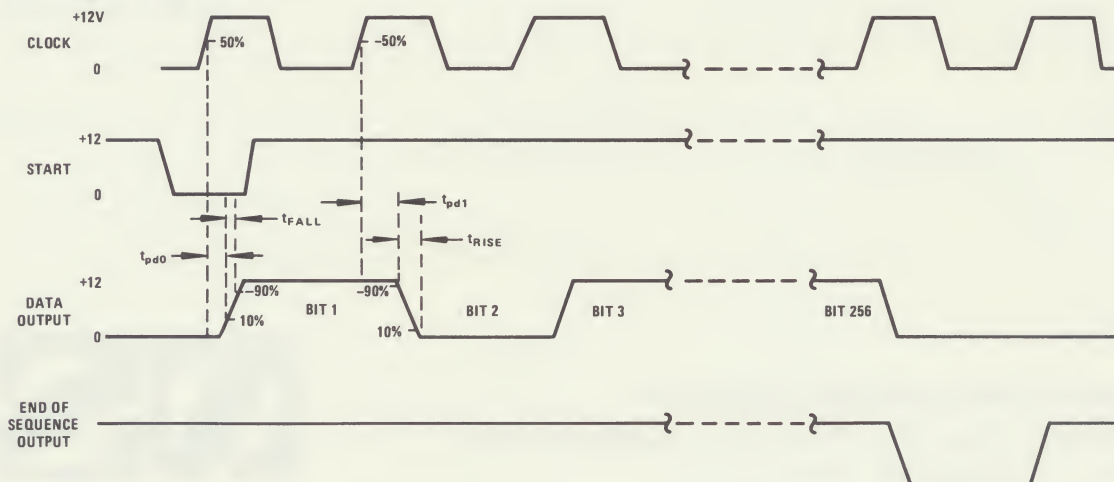
The MM420 and MM520 are 256-bit read only memories which have a clocked serial output. They are ideally suited for character generators, read only drum type memories, micro programming for control and operating programs, and memory systems that are completely interrogated upon command. The device is constructed on a single silicon chip using MOS P-channel enhancement mode transistors. It contains all counters and

decoders for addressing the memory array. A sense amplifier on the chip provides improved speed and noise immunity. An end of sequence output is provided to allow expanding the serial bit length without external components. The memory contents are programmed to individual customer specification during the metalization process of device fabrication.

schematic and connection diagram



timing diagram



TENTATIVE DATA: AUGUST 1968

MM420/MM520 256 bit memory

MM420/MM520 256 bit memory

absolute maximum ratings

$-V_2$ Supply Voltage	-20V
$+V_1$ Supply Voltage	+20V
Input Voltage	$+V_1 + 0.5V$ $-(20 - V_1)V$
Storage Temperature	$-65^{\circ}C$ to $+150^{\circ}C$
Operating Temperature	MM420 $-55^{\circ}C$ to $+125^{\circ}C$ MM520 $0^{\circ}C$ to $70^{\circ}C$
Lead Temperature (Soldering, 60 sec)	$300^{\circ}C$

electrical characteristics (Note 1)

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Logical "1" Output Voltage				+1	V
Logical "0" Output Voltage		+10			V
Logical "1" Input Voltage				+3.0	V
Logical "0" Input Voltage		+9.3			V
Power Dissipation			100		mW
Maximum Clock Frequency			0.5		MHz
Minimum Clock Frequency		DC			
Transient Performance					
t_{RISE}	See Timing Diagram		0.5		μs
t_{FALL}	$C_{LOAD} = 10 pF$		0.2		μs
t_{pd1}			1.5		μs
t_{pd0}			1.5		μs

NOTE 1: These specifications apply for $+V_1 = 12V \pm 10\%$ and $-V_2 = -12V \pm 10\%$, unless otherwise specified.

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MM422/MM522 1024-bit read only memory

general description

The MM422/MM522 is a 1024-bit static read only memory. It is a P-channel enhancement mode monolithic MOS integrated circuit utilizing low threshold voltage technology. The device is a non-volatile memory organized as 128-8-bit words or 256-4-bit words. Programming of the memory contents is accomplished by changing one mask during the device fabrication.

features

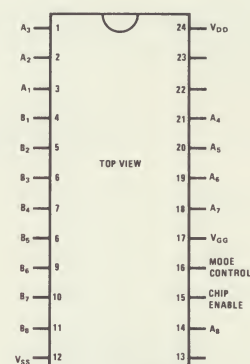
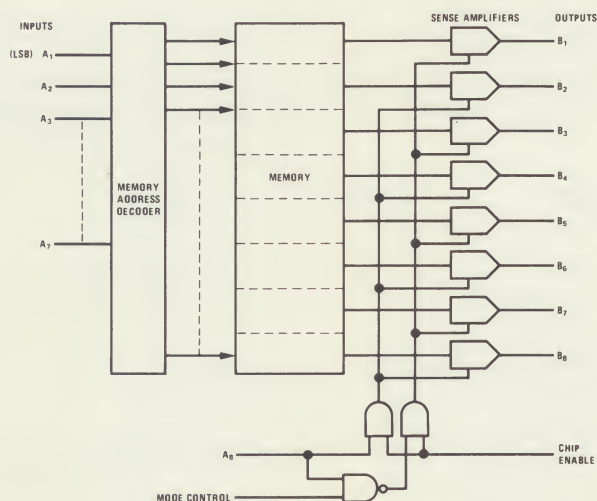
- Bipolar Compatibility
- High Speed Operation — $<1.0 \mu s$ TYP.

- Static Operation — no clocks required
- Common Data Bussing — output wire AND capability
- Chip Enable Output Control

applications

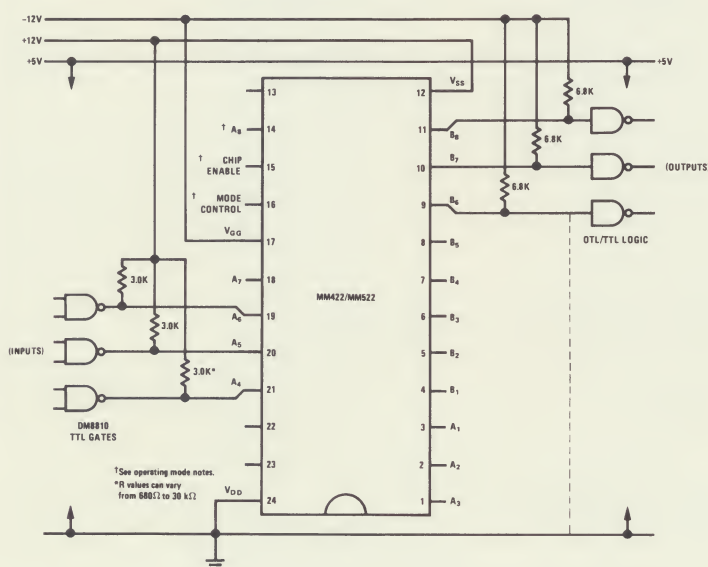
- Code Conversion
- Random Logic Synthesis
- Table Look-up
- Character Generators
- Micro-programming

block and connection diagrams



typical application

128x8 Bit ROM Showing TTL Interface



Operating Modes

128x8 ROM connection
Mode Control — Logic "0"
A₈ — Logic "1"

256x4 ROM connection
Mode Control — Logic "1"
A₈ — Logic "0" Enables the odd (B₁...B₇) outputs
— Logic "1" Enables the even (B₂...B₈) outputs.

The outputs are "Enabled" when a logic "1" is applied to the Chip Enable line.

The outputs are connected to V_{DD} through an internal MOS resistor when "Disabled."

absolute maximum ratings

V _{GG} Supply Voltage	V _{SS} -30V
V _{DD} Supply Voltage	V _{SS} -15V
Input Voltage	(V _{SS} -20)V < V _{IN} < (V _{SS} +0.3)V
Storage Temperature	-65°C to +150°C
Operating Temperature	MM422 -55°C to +125°C
MM522	-25°C to +70°C
Lead Temperature (Soldering, 10 sec)	300°C

electrical characteristics (Note 1)

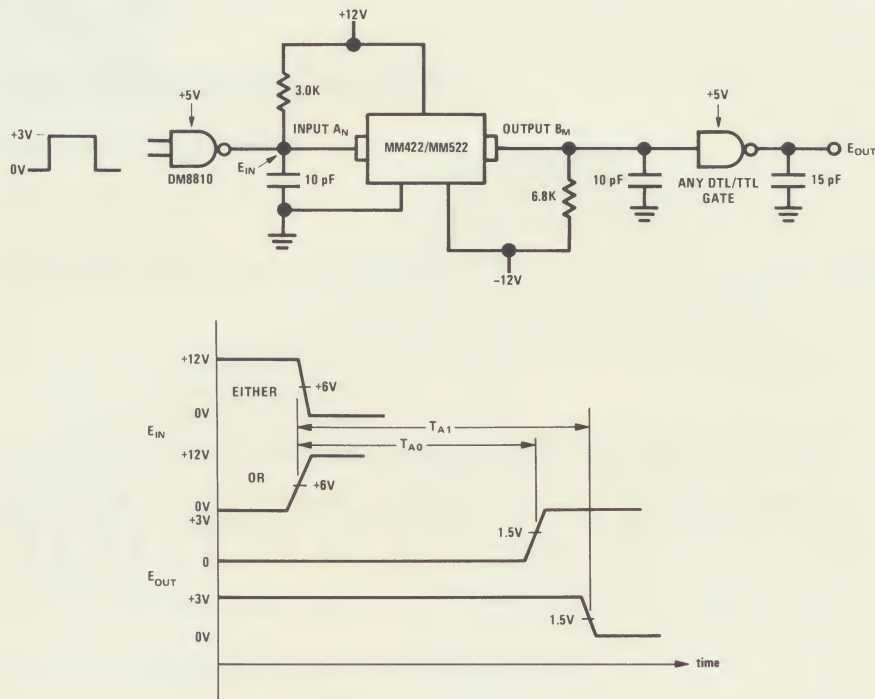
PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Output Voltage Levels					
MOS to MOS					
Logical "1"	1 MΩ to GND Load (Note 2)	V _{SS} -1.0		V _{SS} -9.0	V
Logical "0"					V
MOS to TTL					
Logical "1"	6.8 kΩ to V _{GG} Plus One Standard Series 54/74 Gate Input	+2.5		+0.4	V
Logical "0"					V
Input Voltage Levels					
Logical "1"		V _{SS} -2.0		V _{SS} -8.0	V
Logical "0"					V
Power Supply Current Requirements	T _A = 25°C				
V _{SS}			20	35	mA
V _{GG} (Note 2)				1	μA
Input Leakage	V _{IN} = V _{SS} -12V			1	μA
Input Capacitance	f = 1.0 MHz V _{IN} = 0V		5		pF
Address Time (Note 3)	T _A = 25°C				
T _{A1}	See Timing Diagram		550	1000	ns
T _{A0}			600	1000	ns
Output AND Connection	MOS Load			4	
	TTL Load			10	

Note 1: These specifications apply for V_{SS} = +12V ±10% and V_{GG} = -12V ±10% and T_A = -55°C to +125°C (MM422), T_A = -25°C to 70°C (MM522) unless otherwise specified.

Note 2: The V_{GG} supply may be clocked to reduce device power without affecting access time.

Note 3: Address time is measured from the change of data on any input or Chip Enable line to the output of a TTL gate. (See Timing Diagram.)

timing diagram/address time



pattern selection form

The memory contents for individual requirements must be submitted on an 8-1/2" X 11" size of the form below. For copies of the MM422/522 Bit Selection form, write or call local National Sales office or National, Santa Clara.

National Semiconductor		1024 BIT READ ONLY MEMORY	
2975 San Ysidro Way - Santa Clara, Calif. 95051		PATTERN SELECTION	
NAME		DATE	
ADDRESS		CUSTOMER PRINT OR I.D. NO.	
CITY		PURCHASE ORDER NO.	
PHONE		AUTHORIZED SIGNATURE	
<p>THE FOLLOWING PATTERN IS REQUIRED (ON MY MM422 -55° C TO +125° C <input type="checkbox"/> ; MM522 -25° C TO +70° C <input type="checkbox"/> ;)</p> <p>ENTER DESIRED 8 BIT CODE FOR EACH INPUT ADDRESS: INPUT ADDRESS IS A7, A6, A5, A4, A3, A2, A1.</p>			
ADD- RESS	OUTPUT CODE	ADD- RESS	OUTPUT CODE
0		43	
1		44	
2		45	
3		46	
4		47	
5		48	
6		49	
7		50	
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NOTE: 1 MORE NEGATIVE OUTPUT
0 MORE POSITIVE OUTPUT

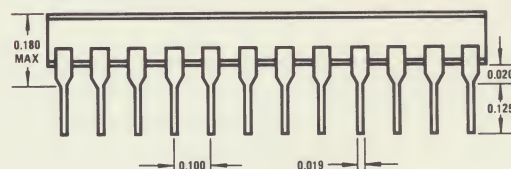
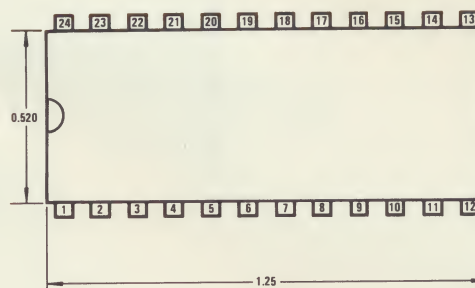
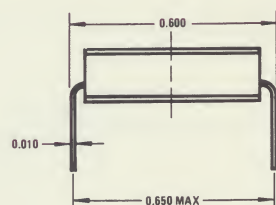
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USE ONLY
DEVICE NO. MM-22-

MM422/MM522 1024-bit read only memory

physical dimensions



Hermetic Dual-In-Line Package
Order Number MM422 or MM522

National Semiconductor Corporation

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(408) 732-5000 / TWX (910) 339-9240



absolute maximum ratings

V_{GG} Supply Voltage	$V_{SS} - 30V$
V_{DD} Supply Voltage	$V_{SS} - 15V$
Input Voltage	$(V_{SS} - 20)V < V_{IN} < (V_{SS} + 0.3)V$
Storage Temperature	$-65^{\circ}C$ to $+150^{\circ}C$
Operating Temperature MM423	$-55^{\circ}C$ to $+125^{\circ}C$
MM523	$-25^{\circ}C$ to $+70^{\circ}C$
Lead Temperature (Soldering, 10 sec)	$300^{\circ}C$

electrical characteristics (Note 1)

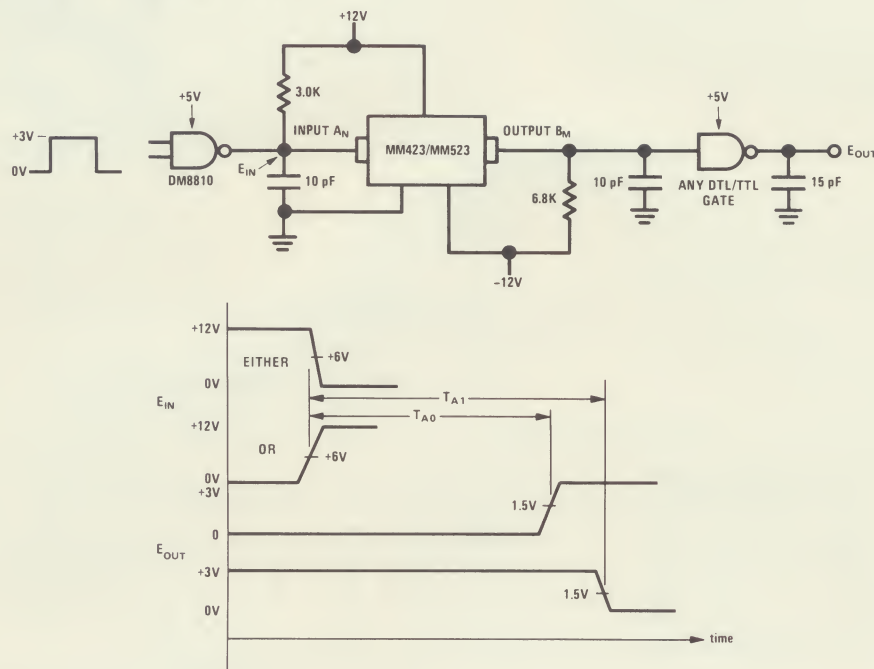
PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Output Voltage Levels					
MOS to MOS					
Logical "1"	1 M Ω to GND Load	$V_{SS} - 1.0$		$V_{SS} - 9.0$	V
Logical "0"					V
MOS to TTL					
Logical "1"	6.8 k Ω to V_{GG} Plus One Standard Series 54/74 Gate Input	+2.5		+0.4	V
Logical "0"					V
Input Voltage Levels					
Logical "1"		$V_{SS} - 2.0$		$V_{SS} - 8.0$	V
Logical "0"					V
Power Supply Current	$T_A = 25^{\circ}C$		24		
V_{SS}				35	mA
V_{GG} (Note 2)				1	μA
Input Leakage	$V_{IN} = V_{SS} - 12V$			1	μA
Input Capacitance	f = 1.0 MHz $V_{IN} = 0V$		5		pF
Address Time (Note 3)					
T_{A1}	See Timing Diagram		850	1500	ns
T_{A0}			500	1500	ns
Output AND Connection	MOS Load			4	
	TTL Load			10	

Note 1: These specifications apply for $V_{SS} = +12V \pm 10\%$ and $V_{GG} = -12V \pm 10\%$ and $T_A = -55^{\circ}C$ to $+125^{\circ}C$ (MM423), $T_A = -25^{\circ}C$ to $70^{\circ}C$ (MM523) unless otherwise specified.

Note 2: The V_{GG} supply may be clocked to reduce device power without affecting access time.

Note 3: Address time is measured from the change of data on any input or Chip Enable line to the output of a TTL gate. (See Timing Diagram.)

timing diagram/address time

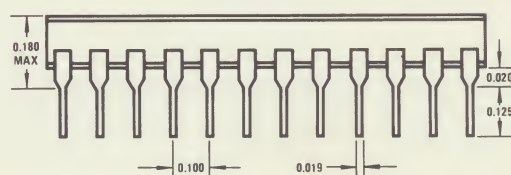
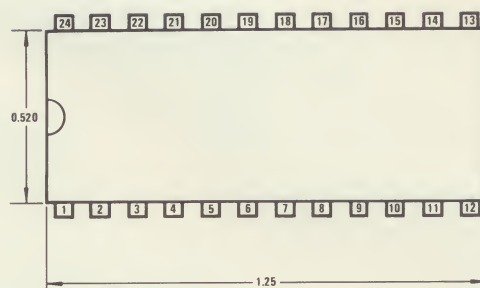
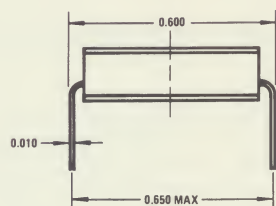


pattern selection form

The memory contents for individual requirements must be submitted on an 8-1/2" X 11" size of the form below. For copies of the MM423/523 Bit Selection form, write or call local National Sales office or National, Santa Clara.

National Semiconductor Corporation		2048 BIT READ ONLY MEMORY		Page <input type="checkbox"/> of 2 <input type="checkbox"/> (1)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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THE FOLLOWING PATTERN IS REQUIRED (ON MY MM423-55° C TO +125° C <input type="checkbox"/> ; MM523-25° C TO +70° C <input type="checkbox"/>) ENTER DESIRED 8 BIT CODE FOR EACH INPUT ADDRESS: INPUT ADDRESS IS A8, A7, A6, A5, A4, A3, A2, A1. A8 = <input type="checkbox"/> (1)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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NOTES: (1) ON PAGE 2, A8 SHOULD BE 0, A7 SHOULD BE 1. (2) "ADDRESS AT THROUGH A1" SIGNIFIES THE LEAST SIGNIFICANT 7 BITS OF THE INPUT ADDRESS IN DECIMAL NOTATION. (3) 1 MORE NEGATIVE OUTPUT 0 MORE POSITIVE OUTPUT 409-102-76 NS MARKETING																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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physical dimensions



Hermetic Dual-In-Line Package
Order Number MM423 or MM523

National Semiconductor Corporation

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(408) 732-5000 / TWX (910) 339-9240





DIGITAL DISPLAY SYSTEMS

TTL-compatible MOS storage circuits solve a dilemma that has plagued display designers: the question of how to generate the display. Eliminating digital-to-analog conversion allows a data system to remain digital right up to the display drivers, but may exchange one economic headache for another. If the data source generates the digital control signal, its cost and that of communications links rise. Doing the job in the terminal, on the other hand, has made displays costly in the past.

MOS read-only memories reduce, to a few relatively inexpensive integrated circuits, the hardware required to convert a character communications code to signals that will control a display. Display rates fast enough for most applications can be achieved, when the MOS ROMs are controlled by bipolar logic circuits. And when the ROMs and bipolar ICs can be coupled directly, without the use of special voltage translators, the character generator becomes that much more inexpensive.

Two cases in point are shown in Figures 1 and 2. The MOS read-only memories can be bought for less than 2¢ per bit of storage. A small additional investment in MOS registers and TTL counters will produce a display-control system, such as the one in Figure 3. This system adds data buffering, message storage and display refresh to the basic character-generation function.

Ordinarily, read-only memories are custom-made and programmed for special applications. A large order must be placed to amortize the setup costs and bring the price below 2¢ per bit. These ROMs are different. They are mass-produced as preprogrammed, off-the-shelf kits. Each kit contains three 1024-bit ROMs programmed to generate 64 alphanumeric display symbols when addressed by the ASCII code. The kit for raster-scan displays is SK0001 and the kit for vertical scanning is SK0002. Figure 4 shows how the characters in the raster-scan font look on a television-type display.

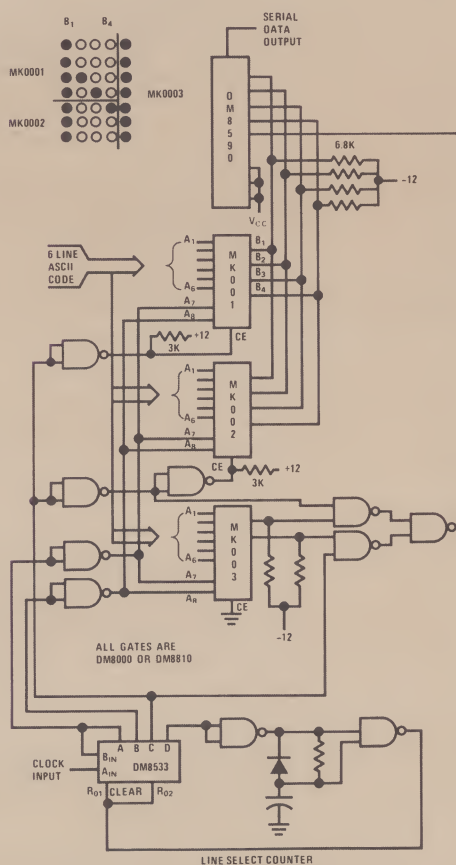


FIGURE 1. Raster-Scan MOS/TTL Display Character Generator.

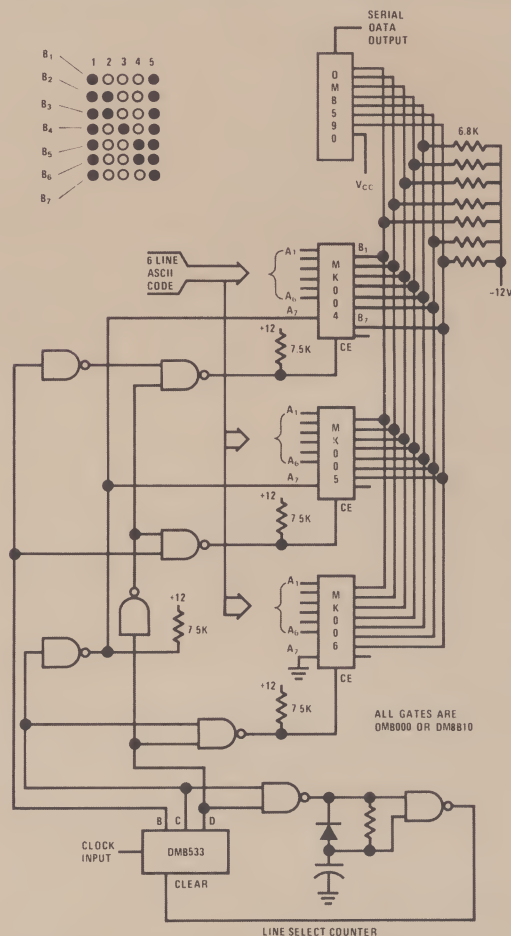


FIGURE 2. Character Generator for Tape Printers and Other Vertical-Scan Applications.



NATIONAL SEMICONDUCTOR MOS GUIDE



6

TEMP. RANGE	PROD. TYPE NO. #	PRODUCT DESCRIPTION	NO. OF BITS	NO. OF CLOCKS	MAX. OPER. FREQ. (MHz)	POWER DISSIPATION mW/MHz/bit	V _{SS} (V)	V _{DD} (V)	V _{GG} (V)	V _S (V)	PKG. TYPE	TEMP. RANGE	PROD. TYPE NO. #	PRODUCT DESCRIPTION	NO. OF BITS	MAX. OPER. FREQ. (MHz)	POWER DISSIPATION mW/MHz/bit	V _{SS} (V)	V _{DD} (V)	V _{GG} (V)	PKG. TYPE
DYNAMIC SHIFT REGISTERS																					
MIL	MM400	Dual 25 bit Shift Register	50	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99	MIL	MM480	Dual 3 Input NOR Gate	N/A	200 ns	10	+10	GND	None	TO-100
	MM401*	Dual 25 bit Shift Register	50	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM481	Dual Exclusive OR Gate	N/A	400 ns	10	+10	GND	None	TO-100
	MM402	Dual 50 bit Shift Register	100	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM482	Dual Digital Multiplex Switch	N/A	400 ns	15	+10	GND	None	TO-100
	MM403*	Dual 50 bit Shift Register	100	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM483	JK Flip Flop	N/A	2.0 MHz	13	+10	GND	None	TO-100
	MM406	Dual 100 bit Shift Register	200	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM580	Dual 3 Input NOR Gate	N/A	200 ns	10	+10	GND	None	TO-100
	MM407*	Dual 100 bit Shift Register	200	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM581	Dual Exclusive OR Gate	N/A	400 ns	10	+10	GND	None	TO-100
COM	MM410	Dual 64 bit Accumulator/Register	128	2	4.0	0.8	+10	None	+10 to -6	-6	TO-100	COM	MM582	Dual Digital Multiplex Switch	N/A	400 ns	15	+10	GND	None	TO-100
	MM4015†	Triple 60H4 bit Accumulator/Register	192	2	1.0	0.3	+5	None	+5 to -12	-12	DIP		MM583	JK Flip Flop	N/A	2.0 MHz	13	+10	GND	None	TO-100
	MM500	Dual 25 bit Shift Register	50	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		LOGIC ELEMENTS								
COM	MM501*	Dual 25 bit Shift Register	50	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99	COM	MM450	Dual Diff. Analog Switch	±10V	200 pA	6000	10 pF	TO-100	DPDT	
	MM502	Dual 50 bit Shift Register	100	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM451	Four Channel Analog Switch	±10V	200 pA	6000	10 pF	TO-100	SP4T	
	MM503*	Dual 50 bit Shift Register	100	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM452	Four MOS Transistor Package	±10V	200 pA	6000	10 pF	TO-100	4PST	
	MM506	Dual 100 bit Shift Register	200	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM453	DTL/TTL Compatible Dual Diff. Switch	±10V	200 pA	6000	10 pF	TO-100	DPDT	
	MM507*	Dual 100 bit Shift Register	200	2	1.0	0.8	+10 ¹	GND	+10 to -6	None	TO-99		MM454	Four Channel Analog Commutator	±10V	200 pA	6000	6 pF	TO-100	SP4T	
	MM510	Dual 64 bit Accumulator/Register	128	2	4.0	0.8	+10	None	+10 to -6	-6	TO-100		MM455	Three MOS Transistor Package	±10V	200 pA	6000	10 pF	TO-100	3PST	
MIL	MM404	Dual 16 bit Shift Register	32	1	1.0	1.6	+10	GND	+10 to -6	-6	TO-99	MIL	MM550	Dual Diff. Analog Switch	±10V	20 nA	6000	10 pF	TO-100	DPDT	
	MM405	Dual 32 bit Shift Register	64	1	1.0	1.6	+10	GND	+10 to -6	-6	TO-99		MM551	Four Channel Analog Switch	±10V	20 nA	6000	10 pF	TO-100	SP4T	
	MM408	8 bit Serial In-Parallel Out Register	8	1	1.0	1.6	+10	None	+10 to -6	-6	DIP		MM552	Four MOS Transistor Package	±10V	20 nA	6000	10 pF	TO-100	4PST	
	MM409	8 bit Parallel In-Serial Out Register	8	1	1.0	1.6	+10	None	+10 to -6	-6	DIP		MM553	DTL/TTL Compatible Dual Diff. Switch	±10V	20 nA	6000	10 pF	TO-100	DPDT	
	MM4050†	Dual 32 bit Shift Register	64	1	1.0	1.6	+5	None	+5 to -12	-12	TO-100		MM554	Four Channel Analog Commutator	±10V	20 nA	6000	6 pF	TO-100	SP4T	
	MM4051†	Dual 32 bit Shift Register Split Clock	64	1	1.0	1.6	+5	None	+5 to -12	-12	TO-100		MM555	Three MOS Transistor Package	±10V	20 nA	6000	10 pF	TO-100	3PST	
COM	MM504	Dual 16 bit Shift Register	32	1	1.0	1.6	+10	GND	+10 to -6	-6	TO-99	COM	MM550	Dual Diff. Analog Switch	±10V	20 nA	6000	10 pF	TO-100	DPDT	
	MM505	Dual 32 bit Shift Register	64	1	1.0	1.6	+10	GND	+10 to -6	-6	TO-99		MM551	Four Channel Analog Switch	±10V	20 nA	6000	10 pF	TO-100	SP4T	
	MM508	8 bit Serial In-Parallel Out Register	8	1	1.0	1.6	+10	None	+10 to -6	-6	DIP		MM552	Four MOS Transistor Package	±10V	20 nA	6000	10 pF	TO-100	4PST	
	MM509	8 bit Parallel Serial Out Register	8	1	1.0	1.6	+10	None	+10 to -6	-6	DIP		MM553	DTL/TTL Compatible Dual Diff. Switch	±10V	20 nA	6000	10 pF	TO-100	DPDT	
	MM5050†	Dual 32 bit Shift Register	64	1	1.0	1.6	+5	None	+5 to -12	-6	DIP		MM554	Four Channel Analog Commutator	±10V	20 nA	6000	6 pF	TO-100	SP4T	
	MM5051†	Dual 32 bit Shift Register Split Clock	64	1	1.0	1.6	+5	None	+5 to -12	-12	TO-100		MM555	Three MOS Transistor Package	±10V	20 nA	6000	10 pF	TO-100	3PST	
READ ONLY MEMORIES (ROM)																					
MIL	MM420	256 bit Function Generator	256	0.25	1.0	100 mW Total	+12	GND	-12	None	TO-99	MIL	NH0007	Single Phase Clock Driver	12 - 30	±300	5	Yes	5	1	800
	MM421	1024 bit ROM (256 x 4)	1024	1.0	1.0	250 mW Total	+12	GND	-12	None	DIP		NH0009	Two Phase Clock Driver	12 - 30	±500	2	Yes	0	2	1500
	MM422	1024 bit ROM (128 x 8)	1024	1.0	1.0	250 mW Total	+12	GND	-12	None	DIP		NH0012	Single Phase Clock Driver	12 - 30	±1000	10	Yes	20	1	1500
	MM423	2048 bit ROM (256 x 8 or 512 x 4)	2048	1.0	1.0	350 mW Total	+12	GND	-12	None	DIP		NH0013	Two Phase Clock Driver	12 - 30	±500	5	No	0	2	1500
COM	MM520	256 bit Function Generator	256	0.25	1.0	100 mW Total	+12	GND	-12	None	TO-99	COM	NH0007C	Single Phase Clock Driver	12 - 30	±300	5	Yes	5	1	800
	MM521	1024 bit ROM (256 x 4)	1024	1.0	1.0	250 mW Total	+12	GND	-12	None	DIP		NH0009C	Two Phase Clock Driver	12 - 30	±500	2	Yes	0	2	1500
	MM522	1024 bit ROM (128 x 8)	1024	1.0	1.0	250 mW Total	+12	GND	-12	None	DIP		NH0012C	Single Phase Clock Driver	12 - 30	±1000	10	Yes	20	1	1500
	MM523	2048 bit ROM (256 x 8 or 512 x 4)	2048	1.0	1.0	350 mW Total	+12	GND	-12	None	DIP		NH0013C	Two Phase Clock Driver	12 - 30	±500	5	No	0	2	1500
	SK0001	3 Package Character Generator Kit	2240	1.0	1.0	250 mW Total/Pkg	+12	GND	-12	None	DIP		*MM401, MM501, MM403, MM503, MM407, and MM507 are identical to MM400, MM500, MM402, MM405, and MM506 respectively, except that they include a 20 KΩ pullup resistor.								
	SK0002	3 Package Character Generator Kit	2240	1.0	1.0	250 mW Total/Pkg	+12	GND	-12	None	DIP		**Temperature Ranges: (COM) Commercial (-25°C to +70°C), (MIL) Military (-55°C to +125°C)								
***Flat Package is 14 lead similar to TO-86 package.																					
†See MM400/500 Series Dynamic Shift Register data sheet for operation on V _{DD} = -5V, V _{SS} = +5V at reduced operating frequency																					
‡Second generation designs incorporating improved bipolar compatibility and output driver characteristics																					
§All devices can be designed for bipolar compatibility without using level translator devices.																					

†All devices can be based for bipolar compatibility without using level translator devices.



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J. L. Montgomery, Inc.
19400 W. Ten Mile Road, Suite 11B
Southfield, Michigan 48075
(313) 358-2616
TWX: 810-224-4981

MINNESOTA

Stan Clothier Co.
7400 Lyndale Avenue S.
Minneapolis, Minnesota 55423
(612) 869-3231
TWX: 910-576-3415

MISSOURI

Florence & Meyer Inc.
8650A Airport Road
Berkeley, Missouri 63134
(314) JA1-6800
TWX: 910-760-1625

NEW JERSEY

NATIONAL SEMICONDUCTOR
MID-ATLANTIC REGIONAL OFFICE
West Cliff House
2375 Hudson Terrace
Fort Lee, New Jersey 07024
(210) 461-6111
TWX: 710-991-9795

Thomas Associates, Inc. (Philadelphia)
138 Haddon Avenue
Haddonfield, New Jersey 08033
(609) 854-3011 or (215) MA7-6613
TWX: 710-896-0606

NEW YORK

NATIONAL SEMICONDUCTOR
DISTRICT SALES OFFICE
99 Park Avenue
Rochester, New York 14607
Rochester: (716) 461-1070
Syracuse: (315) 699-2924

Advanced Components Corp. (Upstate N.Y.)
P.O. Box 248
South Bay Rd.
N. Syracuse, New York 13212
(315) 699-2671
TWX: 710-541-0439

E.R.A., Inc.
330 Great Neck Road
Great Neck, New York 11021
(516) HU2-9320
TWX: 510-223-0836

NORTH CAROLINA

Mount & Company
P.O. Box 17365
Raleigh, North Carolina 27609
(919) 787-8731
TWX: 301-365-8668

OHIO/PENNSYLVANIA/ W. VIRGINIA/KENTUCKY

Gibson Electronics Marketing, Inc.
BelAire Office Building
26100 Brush Avenue
Cleveland, Ohio 44132
(216) 731-8330

Gibson Electronics Marketing, Inc.
5335 Far Hills Avenue
Dayton, Ohio 45429
(513) 434-7860
TWX: 810-459-1976

TEXAS

NATIONAL SEMICONDUCTOR
DISTRICT SALES OFFICE
925 W. Garland
Garland, Texas 75040
(214) 276-0518
TWX: 910-860-5097

Carter Associates, Inc.
P.O. Box 87
Garland, Texas 75080
(214) 276-7151
TWX: 910-860-5097

UTAH

Packer Associates
P.O. Box 15006
Salt Lake City, Utah 84115
(801) 364-1163

WASHINGTON

Electronic Sales Corporation
621 S. Michigan St.
Seattle, Washington 98108
(206) 767-3160
TWX: 910-444-2054

STOCKING DISTRIBUTORS

ALABAMA

Gulf Electronics Corporation
3804 6th Avenue West
Huntsville, Alabama 35805
(205) 837-6100
TWX: 810-726-2231

ARIZONA

Hyler/Cramer Electronics, Inc.
2816 North 16th Street
Phoenix, Arizona 85006
(602) 263-1112
TWX: 910-951-1382

Liberty Electronics
3612 North 16th Street
Phoenix, Arizona 85016
(602) 264-4438
TWX: 910-951-4282

CALIFORNIA

Elmar Electronics (No. Calif.)
2288 Charleston Road
Mtn. View, California 94040
(415) 961-3611
TWX: 910-379-6437

Intermark Electronics
100 Industrial Road
San Carlos, California 94070
(415) 592-1641

Intermark Electronics
4301 Birch Street
Newport Beach, California 92660
(714) 540-1322 or (213) 537-4664
TWX: 910-595-1583

Kierulff Electronics, Inc. (So. Calif.)
2585 Commerce Way
Los Angeles, California 90022
(213) 685-5511
TWX: 910-580-3106

Kierulff Electronics, Inc. (So. Calif.)
8797 Balboa
San Diego, California 92123
(714) 278-2112
TWX: 910-335-1182

Liberty Electronics Corporation (So. Calif.)
339 South Isis Avenue
Inglewood, California 90301
(213) 776-6252
TWX: 910-328-6168

Western Radio Corporation
1415 India Street
San Diego, California 92101
(714) 239-0361

COLORADO

Hyler/Cramer Electronics, Inc.
5465 E. Evans Place at Hudson
Denver, Colorado 80222
(303) 758-2100
TWX: 910-931-0440

Newark-Denver Electronics Supply Co.
P.O. Box 22045
Denver, Colorado 80222
(303) 757-3351
TWX: 910-931-0479

CONNECTICUT

Connecticut Industrial Electronics, Inc.
854 Main Street
Stamford, Connecticut 06902
(203) 325-3591

R&D Electronic Supply Co., Inc.
15 Church Street
Meriden, Connecticut 06450
(203) 238-2344

FLORIDA

Gulf Electronics Corporation
Box 514
Miami, Florida 33166
(305) 887-6541
TWX: 810-848-7641

Hamilton Electro Sales
419 27th Street
Orlando, Florida 32806
(305) 251-5461
TWX: 810-850-0159

Hammond Electronics Inc.
911 W. Central Boulevard
Orlando, Florida 32805
(305) 241-6601
TWX: 810-850-4121

ILLINOIS

Arco Electronics, Inc.
P.O. Box 66289
O'Hare Int'l Airport
Chicago, Illinois 60666
(312) 439-8100

Hall-Mark Electronics Midwest (Chicago Area)
7110 Lyndon Avenue
Rosemont, Illinois 60018
(312) 299-6602
TWX: 910-233-2404

Hamilton Electro Sales
920 So. Westwood Avenue
Addison, Illinois 60101
(312) 543-8500
TWX: 910-651-4952

Avnet Electronics (Chicago Area)
3901 Pace Court
Schiller Park, Illinois 60176
(312) 678-6310
TWX: 910-227-3565

INDIANA

Fort Wayne Electronics Supply, Inc.
3606 East Maumee Avenue
Fort Wayne, Indiana 46803
(219) 742-4346

Graham Electronics Supply, Inc.
133 S. Pennsylvania Street
Indianapolis, Indiana 46204
(317) 634-8486

IOWA

Deco, Inc.
2500 16th Ave. S.W.
Cedar Rapids, Iowa 52406
(319) 365-7551
TWX: 910-525-1332

KANSAS

Hall-Mark Electronics
2707 West 43rd Street
Kansas City, Kansas 66103
(913) 236-4343
TWX: 910-743-6885

MARYLAND

Cramer Washington
692 Lofstrand Lane
Rockville, Maryland 20850
(301) 424-2700

Hamilton Electro Sales
P.O. Box 8647
Friendship International Airport
Baltimore, Maryland 21240
(301) 796-5000
TWX: 710-862-1868

MASSACHUSETTS

R&D Electronics (Boston Area)
71 Pearl Street
Cambridge, Massachusetts 01922
(617) 864-0400
TWX: 710-320-6617

Schley Electronics (Boston Area)
36 Arlington Street
Watertown, Massachusetts 02172
Main Office: (617) 924-1500
TWX: 710-327-1179

MICHIGAN

Arco Electronics, Inc.
Harvard Plaza, Suite 125
29350 Southfield Rd.
Southfield, Michigan 48075
(313) 352-2044

Avnet Electronics
8900 Telegraph Rd.
Detroit, Michigan 48239
(313) 538-1000

MINNESOTA

Arco Electronics, Inc.
4575 W. 77th Street
Minneapolis, Minnesota 55435
(612) 920-8830
TWX: 910-576-2812

Lew Bonn Co.
7275 Bush Lake Road
Minneapolis, Minnesota 55491
(612) 941-2770

MISSOURI

Hall-Mark Electronics
6100 Madison Street
St. Louis, Missouri 63134
(314) 521-3800
TWX: 910-760-1630

Hamilton Electro Sales
400 Brooks Lane
Hazelwood, Missouri 63042
(314) PE1-1144

NEW JERSEY

Hamilton Electro Sales
1608 Marlton Pike, Rt. 70
Cherry Hill, New Jersey 08034
(609) 662-9337
TWX: 710-892-1204

Hamilton Electro Sales
220 Little Falls Road
Cedar Grove, New Jersey 07009
(201) 239-0800

Schley Electronics (No. N.J.)
Industrial Drive
Rutherford, New Jersey 07070
(201) 935-2120
TWX: 710-989-0225

NEW MEXICO

Hyler/Cramer Electronics, Inc.
137 Vermont Ave. N.E.
Albuquerque, New Mexico 87108
(505) 265-5767
TWX: 910-989-1679

Kierulff Electronics Inc.
2524 Baylor Drive S.E.
Albuquerque, New Mexico 87119
(505) 247-1055
TWX: 910-989-1693

NEW YORK

Cramer Electronics
29 Oser Avenue
Hauppauge, New York 11787
(516) 231-5600

Cramer Electronics
3259 Winton Road South
Rochester, New York 14623
(716) 275-0300

Federal Electronics
Box 1208
Binghamton, New York 13902
(607) 748-8211

Hamilton Electro Sales
222 Boss Rd.
Syracuse, New York 13211
(315) 437-2641
TWX: 710-541-0558

Semiconductor Concepts, Inc.
195 Engineers Rd.
Hauppauge, L.I., New York 11787
(516) 273-1234
TWX: 510-227-6232

NORTH CAROLINA

Carolina Radio & Supply
838 Huffman
Greensboro, North Carolina 27405
(919) 275-6391

Hamilton Electro Sales
1023 E. Wendover Ave.
Greensboro, North Carolina 27405
(919) 275-9969

OHIO

Gibson Electronic Components
BelAire Office Building
26100 Brush Avenue
Cleveland, Ohio 44132
(216) 731-6820

Gibson Electronic Components
5335 Far Hills Avenue
Dayton, Ohio 45429
(513) 434-7830
TWX: 810-459-1976

Pioneer Standard
Srepco Division
314 Leo Street
Dayton, Ohio 45404
(513) 224-0871

Pioneer Standard
Srepco Division
5403 Prospect Ave.
Cleveland, Ohio 44103
(216) 432-0010

OKLAHOMA

Radio Inc.
903 North Hudson
Oklahoma City, Oklahoma 73102
(405) CE5-1551

Radio Inc., Industrial Electronics
1000 South Main
Tulsa, Oklahoma 74119
(918) 587-9124

PENNSYLVANIA

Pioneer Standard
Srepco Division
6704 Beacon Street
Pittsburgh, Pennsylvania 15217
(412) 391-4846

SOUTH CAROLINA

Carolina Radio Supply Co., Inc.
221 West Washington Street
Greenville, South Carolina 29601
(803) 239-5125

TEXAS

G.S. Marshall Company
2607 Andjon Street
Dallas, Texas 75220
(214) 358-0161

Hall-Mark Electronics
8000 Westglen
Houston, Texas 77042
(713) 781-6100
TWX: 910-881-2711

Hall-Mark Electronics
P.O. Box 9906
Austin, Texas 78757
(512) 454-4838
TWX: 910-874-1395

Hamilton Electro Sales
2344 Irving Blvd.
Dallas, Texas 75207
(214) 638-0900

Solid State Electronics Company of Texas
P.O. Box 20299
Dallas, Texas 75220
(214) 352-2601
TWX: 910-861-4394

UTAH

Hyler/Cramer Electronics, Inc.
1425 So. 2nd West
Salt Lake City, Utah 84115
(801) 487-3681
TWX: 910-925-5958

WASHINGTON

Electronic Sales Corporation
621 S. Michigan St.
Seattle, Washington 98108
(206) 767-3160
TWX: 910-444-2054

Liberty Electronics Northwest
5305 2nd Avenue South
Seattle, Washington 98108
(206) RO3-8200

WISCONSIN

Taylor Electric Company
4080 North Port Washington Road
Milwaukee, Wisconsin 53212
(414) 964-4321
TWX: 910-262-3414

CANADA

Electro Sonic Industrial Sales
543 Yonge Street
Toronto 5, Ontario, Canada
(416) 924-9301
TWX: 610-491-2297

Prelo Electronics, Ltd.
480 Port Royal Street, West
Montreal 12, Quebec
Canada
(514) 389-8051
TWX: 610-421-3616

Specialty Electronics Ltd.
2690 Pittsfield Blvd.
Montreal 383, Quebec
Canada
(514) 336-4500
TWX: 610-421-3647

Weber Semad Electronics Ltd.
1111 Finch Avenue West
Downsview, Ontario,
Canada
(416) 635-9880